

Table 3 – Summary of Screening of Remedial TechnologiesAction Alternatives on an AOPC Basis.¹

General Response Action	Remedial Technology	Process Options	Effective ²	Implementable ²	Cost
No Action	None	Not Applicable	Yes for All AOPCs Does not meet RAOs.	Yes for All AOPCs	None
Institutional Controls	Governmental Controls	Commercial Fishing Bans	Yes for All AOPCs Limited to contaminants that accumulate in fish or shellfish. Mainly for commercial fisheries, not very effective for recreational fisheries. Better for controlling human exposures than ecological exposures. More effective if used in conjunction with more active technologies.	Yes for All AOPCs Requires commitment and cooperation of impmenting party to administer and acceptance of Native American tribes and public.	Low
		Waterway Use Restrictions or Regulated Navigation Areas	Yes for All AOPCs Enforcement of restrictions in large waterway is difficult. More effective if used in conjunction with more active technologiessuch as capping, or dredging and capping, where this IC would ensure protection of the capping remedy and equal protection of human and ecological receptors vs. having a limited benefit to human exposures only when used on its own.	Yes for All AOPCs Requires commitment and cooperation of impmenting party to administer and acceptance of Native American tribes and public. Dredging and navigation restrictions would be limited due to excessive navigational use of waterway.	Low
	Proprietary Controls	Deed restrictions, easements, and covenants Land Use/Access Restrictions	Yes for All AOPCs Better for controlling human exposures than ecological exposures. More effective if used in conjunction with more active technologies.	Yes for All AOPCs Requires commitment and cooperation of impmenting party to administer and acceptance of Native American tribes and public.	Low
		Structure Mainenance Agreements	Better for controlling human exposures than ecological exposures. More effective if used in conjunction with more active technologies.	Requires commitment and cooperation of impmenting party to administer and acceptance of Native American tribes and public.	Low

	Enforcement and Permit Tools	Permit Processes or Provisions of Administrative Orders or Consent Decrees	Yes for All AOPCs An action pursuant to the CD, order, or permit generally will be effective only against the parties specified in these documents. For example, a provision in a CD or AOC may require a facility operator to secure a proprietary control to prevent a particular type of land use. However, the land owner may not be a party to the CD or AOC and, therefore, would not be obligated to convey the interest. Furthermore, the requirements of the CD may not be enforceable against any successor-in-title if the successor was not a party to the CD.	Yes for All AOPCs Through these instruments, EPA or another regulatory agency may be able to specify the restrictions and requirements for implementing, maintaining, and/or fixing a breach to the IC in the enforceable document. If the responsible parties fail to carry out their obligations under a CD, order, or permit, EPA or another regulatory agency may be able to enforce those obligations under the appropriate CERCLA authority. The remedies available may include requiring the defendant to implement the IC or, in some circumstances, pay certain costs or penalties. Such payments may be required to reimburse an agency that has incurred the cost of implementing or maintaining the control, cover the costs incurred when addressing IC breaches, and/or pay penalties (stipulated and/or statutory).	Low
	Informational devices	Fish Consumption Advisories	Yes for All AOPCs Limited to contaminants that accumulate in fish or shellfish. Mainly for commercial fisheries, not very effective for recreational fisheries. Better for controlling human exposures than ecological exposures. More effective if used in conjunction with more active technologies.	Yes for All AOPCs Requires commitment and cooperation of implementing party to administer and acceptance of Native American tribes and public.	Low
Natural Attenuation- Monitored Natural Recovery	Monitored Natural Recovery- Physical Transport	Monitored Natural Recovery- Desorption, dispersion, diffusion, dilution, volatilization, resuspension, and transport.	Yes for All AOPCs Physical transport generally increases exposure to contaminants and may result in unacceptable risks to downstream areas or other receiving water bodies.	Yes for All AOPCs MNR works best where the source of pollution has been removed. Need to identify if these processes are occurring sufficient to reduce risk to receptors.	Low

	Chemical and Biological Degradation	Dechlorination (aerobic and anaerobic), bioderadation	Limited to SVOCs and PAHs. Does not result in complete destruction of PCBs in acceptable time frame. Declorination is not directly related to toxicity reduction. Not applicable to metals.	MNR works best where the source of pollution has been removed. Need to identify if these processes are occuring sufficient to reduce risk to receptors.	Low
	Physical Burrial Process	Sedimentation	Works best in depositional areas and areas not subject to routine dredge maintainence. Requires demonstration of long-term deposition and burrial.	MNR works best where the source of pollution has been removed. Need to identify if these processes are occuring sufficient to reduce risk to receptors.	Low
Enhanced Monitored Recovery	Enhanced Burrial/Dilution	Enhanced Monitored Natural Recovery (EMNR)/Thin Layer Placement Thin Layer Cap	Yes for All AOPCs Applicable at areas where MNR processes are demonstrated, but faster recovery is required, or as a residual management tool after completion of removal action.	Yes for All AOPCs EMNR works best where the source of pollution has been removed.	Low-Moderate
Containment in Place	Capping	Engineered Cap Conventional Sand Cap	Yes for All AOPCs Effective for low-solubility and highly sorbed contaminants (e.g., PCBs) where principle transport mechanism is resuspension/deposition. Not effective in potential scour areas from river currents or propeller wash. Not effective in controlling groundwater plumes.	Yes for All AOPCs Requires flood rise analysis and must consider water use, depth requirements, and slope stability.	Moderate-High Low
		Conventional Sand/Clay Cap	Effective for low-solubility and highly sorbed contaminants (e.g., PCBs) where principle transport mechanism is resuspension/deposition. Not effective in potential scour areas from river currents or propeller wash. Not effective in controlling groundwater plumes.	Requires flood rise analysis and must consider water use, depth requirements, and slope stability.	Low
		Armored Cap	Applicable at areas where increased velocities from river flow or potential scouring due to propeller wash might be expected. Not effective in controlling groundwater plumes.	Requires flood rise analysis and must consider water use. May require mitigation if not habitat friendly.	Low-Moderate
		Composite Cap (e.g., HDPE, Geotextile)	Effective in reducing cap thickness, providing additional floor-support, providing bioturbation barrier, or areas where methane generation may be issue.	Requires flood rise analysis and must consider water use.	Low-Moderate

In-Situ Treatment		Active Capping (Engineered Cap with Active Layer) Reactive Cap	Yes for All AOPCs Specific to chemical being managed; may not be effective where multiple types of contaminants (e.g., metals and organics) are co-located.	Yes for All AOPCs Requires flood rise analysis and must consider water use, depth requirements, and slope stability.	High Low-Moderate
		Engineered or Active Caps with Habitat Layers	Yes for All AOPCs	Yes for All AOPCs	Moderate-High
	Biological	Slurry Bioremediation	Limited to organic compounds. Biodegradation has not been demonstrated to effectively remediate metals, PCBs, or TBT within reasonable time frames.	Requires installation of sheet piling around entire area.	Moderate
		Phytoremediation	Typical organic contaminants, such as petroleum hydrocarbons, gas condensates, crude oil, chlorinated compounds, pesticides, and explosive compounds, can be addressed using plant-based methods. Phytotechnologies also can be applied to typical inorganic contaminants, such as heavy metals, metalloids, radioactive materials, and salts.	Technology has only been demonstrated for soil, groundwater, and wetlands. May possibly work in nearshore environment with constructed wetland. Would not be viable in areas where there is vessel traffic since plants may interfere with use.	Low-Moderate
		Aerobic Biodegradation	Biodegradation has not been demonstrated to effectively remediate metals, PCBs, or TBT within reasonable time frames.	Not demonstrated for remediation of sediments. May need to inject oxygen to create aerobic conditions.	Low-Moderate
		Anaerobic Biodegradation	Biodegradation has not been demonstrated to effectively remediate metals, PCBs, or TBT within reasonable time frames.	Not demonstrated for remediation of sediments.	Low-Moderate
		Imbiber Beads	Potentially applicable to PCBs and SVOCs, not metals. No data on effectiveness with TBT.	Not demonstrated for remediation of sediments. Removal and disposal of the blanket is not demonstrated.	Low
	Chemical	Chemical Slurry Oxidation	Contaminants that can be typically treated include: petroleum, diesel, MTBE, BTEX, chlorinated solvents, pesticides and herbicides, carbon disulphide, polychlorinated biphenyls (PCB's), and cyanides and sulphides. Not effectively demonstrated in full-scale application.	Requires in-water steel piling around treatment area and extensive water quality monitoring outside piles.	Moderate
	Physical-Extractive Processes	Oxidation	Effectiveness has not been demonstrated for sediments.	Requires use of injection wells.	Moderate

		Sediment Flushing	Bench scale effective. No known pilot or full-scale applications.	Extraction solution must be treated. Requires in-water steel piling around treatment area and extensive water quality monitoring outside piles.	Moderate
	Contaminant Sequestration Physical - Immobilization	Solidification/Stabilization	Proprietary technology that has been effective in stabilizing metals, PCBs and SVOCs in soil. No data available on TBT, but physical process likely to be effective on butyltins.	Requires treating sediments in place using of 18' x 18' caisson and proprietary injectors. Implementation problems with coal-tar contaminated sediments. Previous trials with this technology created water treatment problems inside the caisson.	Moderate
		Vitrification	Effective stabilizing contaminants in soil applications, but requires less than 60% water content.	Remaining sediment surface may not provide suitable habitat.	High
		Electrochemical Oxidation	Limited to Mercury and PAHs. No demonstrated sediment application.	Requires installation of sheet piling around entire area.	Moderate-High
		Direct Amendment Granulated Activated Carbon (GAC)	Yes for All AOPCs Limited to organic compounds and some metals.	Yes for All AOPCs Works best with lower levels of contaminants.	Low-Moderate
		Ground Freezing	Long-term effectiveness in presence of standing water has not been demonstrated. Standing water likely provides a significant sink for cold temperatures and would substantially increase cost.	Requires installation of pipe array. Recommended only for short-duration applications and to assist with excavation.	High
		Enhanced Cap Materials	Yes for All AOPCs	Yes for All AOPCs	High

Removal	Dredging	Mechanical Dredging, Water Based	Yes for All AOPCs Effective in removing stiffer or denser sediments, but requires greater effort to reduce resuspension rates and residual production. Residuals will require management strategies to achieve cleanup goals. More effective at handling debris. Environmental buckes suitable for softer materials with low debris; clamshell buckets suitable for harder, dense sediments.	Yes for All AOPCs Dredge depths are limited by the ladder and cable lengths. Application in shallow water depths limited by draft of supporting barge or ship. Requires barge to place material during operations. May require contaminant barrier during dredging activities. Although in some cases diver-assisted hydraulic dredging or video-monitored dredging can be used, turbidity, safety and other technological constraints typically result in dredging being performed without visual assistance	Moderate High
		Mechanical Dredging, Land Based Dry Excavation	Yes for All AOPCs Effective where water depths limit conventional dredging equipment.	Yes for All AOPCs Requires installation of sheet pile walls or cofferdam, unless performed in exposed areas during low river stages. Limited application to areas that can be reached from shore or by specialty equipment designed to work on soft unconsolidated sediments. Equipment is locally commercially available. May require contaminant barrier during excavation activities. Although in some cases diver-assisted hydraulic dredging or video-monitored dredging can be used, turbidity, safety and other technological constraints typically result in dredging being performed without visual assistance	High Low-Moderate

		<div>Hydraulic Dredging</div>	<div>Yes for All AOPCs Effective in removing soft or loose sediments with high water content. Capable of lower resuspension rates at the point of dredging, as well as lower in-water residual production than mechanical dredging. Residuals will require management strategies to achieve cleanup goals.</div>	<div>Yes for All AOPCs The presence of large amounts of debris can adversely affect hydraulic dredging operations and may require pre-debris sweeps. Dredge depths are limited by the ladder and cable lengths. Application in shallow water depths limited by draft of supporting barge or ship. Requires close proximity to land-based dewatering facility, barge dewatering facility, or CDF due to pumping limitations. Slurry separation and disposal rates can be slower than dredging rates and may limit the rate of dredging. May require contaminant barrier during dredging activities. Although in some cases diver-assisted hydraulic dredging or video-monitored dredging can be used, turbidity, safety and other technological constraints typically result in dredging being performed without visual assistance. Barge transport of hydraulically dredged material is inefficient</div>	<div>High Moderate</div>
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		Small Scale Dredge Equipment	Yes for All AOPCs Can be conducted close to infrastructure and within tightly restricted areas. Less residuals due to higher precision from dredging operations. May be the most effective approach for precise cleanup of a hard face, since the divers can feel the surface and adjust the excavation accordingly.	Yes for All AOPCs Production rates are much less than other removal equipment mainly due to smaller size of removal equipment a diver can handle. Seldom require contaminant release controls. Barge transport of hydraulically dredged material is inefficient. Ability of divers to maintain a desired position will be hampered by currents. Presence of logs and large debris may present dangerous conditions for diver-assisted dredging. Although divers can remove sediment from around large debris or rocks, this type of operation would be inefficient. Removal is limited to thin cuts.	High
Confinement	Commercial Landfill	Hillsboro	May be limited as to quantity of material that can be accepted. Most effective for materials with the lowest potential to leach constituents. Does not accept RCRA waste.	Requires overland transportation. Shortest haul route reduces transportation-related risks and environmental impacts. However, only alternative that requires trucking through most congested area (Portland). requires elimination of free liquids. Transportation by truck also requires elimination of free liquids. May be less favored by agencies and the public, at least for some materials, because of proximity to metropolitan Portland.	Low
		Northern Wasco County	Adequate capacity. Does not accept RCRA waste. May be limited as to quantity of material that can be accepted.	Longer overhaul travel distance than Hillsboro but mostly by barge. Truck distance is less than half the distance for Hillsboro and through much less densely populated area.	Low-Moderate

		Roosevelt Regional	Adequate capacity. Does not accept RCRA waste.	Accepts wet waste. Rail transportaion available if a transloading facility can be sited in Portland near the river. Differences between Hazardous Waste Regulations in Oregon and Dangerous Waste Regulations in Washington need to be considered. Farther from the Site than Hillsboro or Wasco County but transportation would be mostly by barge or rail.	Moderate
		Columbia Ridge (Subtitle D)	Adequate capacity. Does not accept RCRA waste.	Accepts wet waste. Rail transportaion available if a transloading facility can be sited in Portland near the river.	Moderate
		Chem Waste (Subtitle C)	Adequate capacity. Accepts RCRA waste. Redundant containment and leachate collection systems and location in an area that receives little precipitation and is removed from shallowest groundwater all contribute to long-term effectiveness.	Rail transport available if a transloading facility can be sited in Portland near the river.	High
	Onsite Upland Landfill	No likely candidate property.	Need adequate capacity and proximity/access from site.	Floodplain location makes upland disposal more difficult.	Moderate-High
	Confined Aquatic Disposal (CAD)	Willamette River (RM 4/5)	Need for seasonal capping reduces available capacity. Capacity limited.	Potential for increased releases during disposal. New sites would require flood rise analysis. Mitigation would be required. Would require long-term monitoring and maintenance. Would require navigation restrictions.	High
		Willamette River (RM 9)	Need for seasonal capping reduces available capacity. Capacity limited.	Potential for increased releases during disposal. New sites would require flood rise analysis. Mitigation would be required. Would require long-term monitoring and maintenance. Would require navigation restrictions.	High

		Swan Island Lagoon	Need for seasonal capping reduces available capacity. Capacity limited.	Potential for increased releases during disposal. New sites would require flood rise analysis. Mitigation would be required. Would require long-term monitoring and maintenance. Would require navigation restrictions.	High
		Columbia River (RM 102.5)		Potential for increased releases during disposal.	Moderate
		Ross Island	May be incompatible with RA schedule. Limited capacity available.	Potential for increased releases during disposal.	Moderate
	Confined Disposal Facility (CDF)	Terminal 4 Slip 1	60% design complete.	New sites would require flood rise analysis and mitigation. Would require long-term monitoring and maintenance.	High
		Swan Island Lagoon	Large capacity.	New sites would require flood rise analysis and mitigation.	High-Very High
		Arkema	Limited capacity.	New sites would require flood rise analysis and mitigation.	Very High
Ex-Situ Treatment	Pre-Treatment Physical	In-barge Dewatering	Yes for All AOPCs Degree of debris removal required varies depending upon the requirements of the dewatering equipment and any follow-on treatment processes.	Yes for All AOPCs BMPs are necessary to ensure water quality impacts are minimized. Compatible with either mechanical or hydraulic dredging.	Low-Moderate
		Lagoon Dewatering	Yes for All AOPCs Highly effective, but dependent on climate conditions.	Yes for All AOPCs Large staging areas are required within close proximity to the project. Dewatering could take several months depending on the percentage of fine sediment present and amount of precipitation occurring. Compatible with hydraulic dredging.	Moderate-High Low

Geotextile Tube Dewatering	Yes for All AOPCs Degree of debris removal required varies depending upon the requirements of the dewatering equipment and any follow-on treatment processes.	Yes for All AOPCs Moderate to large staging areas are required within close proximity (~3-5 miles) to the project. Dewatering could take several months depending on the percentage of fine sediment present. Geotextile tubes may work for fine-grained sediments with proper coagulant treatment. In addition, bench scale testing is required to identify appropriate flocculants and dosages. BMPs may be necessary to ensure air quality impacts are minimized. Compatible with hydraulic dredging. Mechanical dredging would require slurring.	Low-Moderate- High
Mechanical Dewatering	Yes for All AOPCs Degree of debris removal required varies depending upon the requirements of the dewatering equipment and any follow-on treatment processes.	Yes for All AOPCs Regular equipment maintenance is required. BMPs may be necessary to ensure air quality impacts are minimized. Compatible with hydraulic or mechanical dredging. Belt filter press circuits are continuous flow processes. Residence time is a matter of minutes. Plate and frame presses are batch processes, usually operated in parallel to achieve continuous operation. Residence time may be longer than for belt filter presses, but probably on the order of minutes to hours. In addition, mechanical dewatering typically requires a slurry feed from a hydraulic dredging operation. Bench scale testing would be needed to determine operational parameters and requirements.	High Low

	Reagent Dewatering	Yes for All AOPCs Degree of debris removal required varies depending upon the requirements of the dewatering equipment and any follow-on treatment processes.	Yes for All AOPCs BMPs may be necessary to ensure air quality impacts are minimized. Compatible with mechanical dredging. this operation is often performed on a barge negating the need for upland processing facilities.	Moderate-High Low
	Particle Separation	No for All AOPCs Effective in reducing volume of highly contaminated material with high sand content. Increases effectiveness of dewatering dredged material. Not effective with sediments containing high concentration material with high organic content. May not be effective with PCBs since they may be retained on sand particles as emulsions.	No for All AOPCs ³ Readily implementable - mobil units available for quick setup and takedown time. Can be combined with soil washing to improve separation. Clean separated sand may be available for potential beneficial use (would require identification of reuse). Bench scale testing to characterize the different size or density fractions is typically needed to assess feasibility.	High Moderate
	Blending	No for All AOPCs	No for All AOPCs ³	High

Cement Solidification/Stabilization	<p>Yes for AOPCs 1, 3, 9U, 11, 12, 13, 15, 16, 17S, 18, 19, 21, 22, 24, 25</p> <p>Bench-scale studies have added immobilizing reagents ranging from Portland cement to lime cement, kiln dust, pozzolan, and proprietary reagents. Lime has been successfully added to dredged material at other projects.</p>	<p>Yes for All AOPCs</p> <p>BMPs are necessary to ensure air quality impacts are minimized. Dewatering prior to cement stabilization/solidification is dependent on logistics. Mechanically dredged sediments will be saturated, but since the volumes of water produced by mechanical dredging are much more limited, blending with stabilizing agents can be done in barges on wet materials. Where hydration of the blending agent is required, some water would actually be desirable. A similar operation could be performed on hydraulically dredged sediments after they have become sufficiently dewatered (passively) to permit handling, or after they were mechanically dewatered.</p>	<p>Low-Moderate-High</p>
Sorbent Clay Solidification/Stabilization	<p>Yes for AOPCs 1, 3, 9U, 11, 12, 13, 15, 16, 17S, 18, 19, 21, 22, 24, 25</p> <p>Allows adsorption of organic contaminants into clay. Not good for organics, due to vapor emission and fire concerns. Factors that influence the performance of S/S include: (1) interfering agents which prevent proper set or curing, including organics (oils, grease, phenols, chlorinated solvents) and inorganics (sulfate, phosphate); (2) gas emissions - since generally exothermic reactions, heat is generated and some volatilization of toxics can occur; and (3) final strength - decreased by organics.</p>	<p>Yes for All AOPCs</p> <p>BMPs are necessary to ensure air quality impacts are minimized. Lime amendment for pH control to allow for adsorption of organic contaminants</p>	<p>High</p> <p>Moderate</p>

		Asphalt Emulsion	Compatible with metals. Not good for organics, due to vapor emission and fire concerns. Higher cost, energy use, flammability, and vapors compared to cement. Factors that influence the performance of S/S include: (1) interfering agents which prevent proper set or curing, including organics (oils, grease, phenols, chlorinated solvents) and inorganics (sulfate, phosphate); (2) gas emissions - since generally exothermic reactions, heat is generated and some volatilization of toxics can occur; and (3) final strength - decreased by organics.	BMPs are necessary to ensure air quality impacts are minimized. Dewatering may be required.	Low-Moderate
		Solar Detoxification	Limited to VOCs, SVOCs, solvents, pesticides and dyes. Not effective for PCBs, dioxins, or TBT. Some heavy metals may be removed. Only effective during daytime with normal intensity of sunlight.	Process has been successfully demonstrated at pilot scale.	Low
	Biological Methods	Land Treatment	Yes for AOPCs 16, 21, and 22 Limited to TPH and PAHs.	Possible for AOPCs 16, 21, and 22 Large staging areas are required within close proximity to the project. BMPs may be necessary to ensure air quality impacts are minimized. If air quality impacts are expected, a contained biological PO may be more appropriate. BMPs are also necessary to control contaminant migration from runoff. Bench-scale testing would be required during design. Requires dewatering of dredged material.	High Low-Moderate

Composting	Limited to TPH and PAHs.	Large staging areas are required within close proximity to the project. BMPs may be necessary to ensure air quality impacts are minimized. If air quality impacts are expected, a contained biological PO may be more appropriate. BMPs are also necessary to control contaminant migration from runoff. Bench-scale testing would be required during design. Requires dewatering of dredged material.	Low-Moderate
Biopiles	Limited to VOCs, SVOCs, and TPH. Not effective for metals, PCBs, TBT, or dioxins. The presence of site COCs such as PCBs, organochlorine pesticides and metals may prevent these technologies from achieving the desired cleanup levels.	Large treatment areas are required. Regular equipment maintenance is required. BMPs are necessary to ensure air quality impacts are minimized. Bench-scale testing would be required during design. Requires dewatering of dredged material.	Low-Moderate
Fungal Biodegradation	Not effective for metals, PCBs, TBT, or dioxins. High concentrations of contaminants may inhibit growth.	Technology has only been demonstrated at bench-scale; no known full-scale applications.	Low-Moderate
Slurry-phase Treatment	Limited to VOCs and SVOCs.	Regular equipment maintenance is required. BMPs are necessary to ensure air quality impacts are minimized. Moisture control is necessary to ensure consistent slurry concentrations are treated. Process water requires treatment and disposal. Bench-scale testing would be required during design.	Moderate

		Enhanced Biodegradation	Target contaminants for enhanced biodegradation processes are nonhalogenated VOCs, nonhalogenated SVOCs, and fuels. Pesticides also should have limited treatability. Nitrate enhancement has primarily been used to remediate ground water contaminated by BTEX. Not effective for metals, PCBs, TBT, or dioxins. PAHs and some SVOCs are amenable to aerobic degradation.	For heterogeneous subsurface it is very difficult to deliver the nitrate or hydrogen peroxide solution throughout every portion of the contaminated zone. Higher permeability zones will be cleaned up much faster because ground water flow rates are greater. Safety precautions must be used when handling hydrogen peroxide. Microbial enzymes and high iron content of subsurface materials can rapidly reduce concentrations of hydrogen peroxide and reduce zones of influence. A ground water circulation system must be created so that contaminants do not escape from zones of active biodegradation. Because air sparging increases pressure in the vadose zone, vapors can build up in building basements, which are generally low pressure areas. Many states prohibit nitrate injection into ground water because nitrate is regulated through drinking water standards. A surface treatment system, such as air stripping or carbon adsorption, may be required to treat extracted ground water prior to re-injection or disposal.	Low-Moderate
	Chemical	Acid Extraction	Suitable for sediments contaminated with metals, but not applicable to PCBs or SVOCs. No data on TBT.	Safety concerns handling acids. Requires dewatering prior to treatment. May need pH adjustment of effluent prior to disposal. Difficulties may be encountered in disposal of liquid hazardous wastes.	Moderate

		Solvent Extraction	Moderate to high. Successfully pilot-demonstrated at New Bedford Harbor which is contaminated with PCBs. Where metals and organics are both present in the sediment, which is typical, chemical extraction targeting organics would likely need to be coupled with other operations addressing removal/stabilization of metals. This demonstration has limited applicability to the Portland Harbor project as the goal of the pilot program was to reduce PCB concentrations to below 50 mg/kg to reduce the waste code from Subtitle C to Subtitle D; therefore, there are limited data available to determine the effectiveness of the pilot in treating to lower concentrations.	Regular equipment maintenance is required. BMPs are necessary to ensure air quality impacts are minimized. Process water and residual wastes require treatment and disposal, which could significantly increase the overall cost of treatment. Bench-scale testing would be required during design.	High
	Physical/Chemical	Sediment Washing	No for All AOPCs Pilot-scale testing showed demonstrated effectiveness for metals, SVOCs and PCBs in sediments. Limited data suggests not effective for TBT. High recalcitrant (e.g., PCBs) contaminant concentrations, increased percentage fines, and high organic content increases overall treatment costs.	No for All AOPCs³ Regular equipment maintenance is required. BMPs are necessary to ensure air quality impacts are minimized. Process water and residual wastes require treatment and disposal, which could significantly increase the overall cost of treatment. Bench-scale testing would be required during design. Ffor some dewatering methods, process residence time is limited to the time required for the slurry to be pumped/flow through the various unit operations. Recycle may be required to achieve sufficient contaminant reduction in some cases, however, which would incrementally increase residence times.	High Moderate

Chemical Oxidation/Reduction	Target contaminant group is inorganics. Less effective for nonhalogenated VOCs, SVOCs, fuel hydrocarbons, and pesticides. Not cost effective for high contaminant concentrations due to large amounts of oxidizing agent required.	Regular equipment maintenance is required. BMPs are necessary to ensure air quality impacts are minimized. Process water and residual wastes require treatment and disposal, which could significantly increase the overall cost of treatment. Bench-scale testing would be required during design.	High
Dehalogenation	Limited to chlorinated organics (PCBs and dioxins). Technology not applicable to metals.	Regular equipment maintenance is required. Generates secondary waste streams of air, water, and sludge. BMPs are necessary to ensure air quality impacts are minimized. Process water and residual wastes require treatment and disposal, which could significantly increase the overall cost of treatment. Bench-scale testing would be required during design.	High
Slurry Oxidation	Applicable to SVOCs, but not PCBs or metals. TBT treatment unknown. High organic carbon content in sediment will increase volume of reagent and cost.	Large volume of tankage required. No known full-scale applications.	High
Radiolytic Dechlorination	Only bench-scale testing has been performed.	Process must be carried out under inert atmosphere. Difficult and expensive to create inert atmosphere for full-scale project.	Very High

Thermal Methods	Incineration	No for All AOPCs High temperatures result in generally complete decomposition of PCBs and other organic chemicals. Effective across wide range of sediment characteristics. Not effective for metals.	No for All AOPCs³ Requires air pollution control device. Mobile treatment may be used, if available, and may more cost effective than offsite thermal treatment if the treatment volumes are high enough. Nearest existing, permitted facility is greater than 500 miles from project. High energy consumption. Potential for dioxin generation is a concern. Public concern may make implementability challenging.	Very High
	Pyrolysis	Limited to SVOCs and pesticides. Not effective in destroying or physically separating inorganics from contaminated medium.	Requires air pollution control device (acid scrubber) to treat off-gas. Nearest existing, permitted facility is greater than 500 miles from project. Mobile treatment may be used, if available, and may more cost effective than offsite thermal treatment if the treatment volumes are high enough. High energy consumption. Potential for dioxin generation is a concern.	High-Very High
	High Temperature Thermal Desorption	No for All AOPCs Target contaminants are SVOCs, PAHs, PCBs, TBT, and pesticides. Metals are not destroyed. Especially effective with high levels of PCBs (>50 ppm).	No for All AOPCs³ Requires air pollution control device. Technology readily available as mobile units that would need to be set up at a fixed location in close proximity to the contaminated sediments. High energy consumption; however, costs may be offset through the sale/use of generated power. Pre-permitting consultation and acceptance of BU products is crucial to economic viability of PO.	High

Low Temperature Thermal Desorption	Effective for SVOCs and PAHs. May have limited effectiveness for PCBs. Metals not destroyed. Effectiveness demonstrated at other sediment remediation sites.	Requires air pollution control device. Fine-grained sediment and high moisture content will increase retention times. Vaporized organic contaminants that are captured and condensed need to be destroyed by another technology. The resulting water stream from the condensation process may require further treatment. Widely-available commercial technology for both on-site and off-site applications.	Low
High Pressure Oxidation	<p>Predominantly for aqueous-phase contaminants. Wet air oxidation is a commercially-proven technology for municipal wastewater sludges. Effectiveness for destruction of PCBs is poor. In bench-scale testing of the process conducted under the ARCS Program, using sediments from Indiana Harbor, it was found that only 35 percent of influent PCBs were destroyed. Technology can degrade hydrocarbons (including PAHs), some pesticides, phenolic compounds, cyanides, and other organic compounds. A bench-scale test using sediments from Indiana Harbor showed greater than 99 percent destruction of PAHs</p> <p>The supercritical water oxidation process is a relatively new technology that has received limited bench- and pilot-scale testing. Available data have shown essentially complete destruction of PCBs and other stable compounds.</p>	Wet air oxidation can operate at pressures of one-tenth those used during supercritical water oxidation.	High

		Vitrification	No for All AOPCs Thermally treats PCBs, SVOCs, and TBT, and stabilizes metals. Successful bench-scale application to treating contaminated sediments lin Lower Fox River and Passaic River.	No for All AOPCs ³ Requires air pollution control device. High energy consumption; however, costs may be offset through the sale/use of generated power or alternative energy sources (e.g., recycled tires) are identified. Pre-permitting and acceptance of BU products is crucial to economic viability of PO. May be effective in stabilizing low concentration metals. Potential for dioxin generation is a concern. Sediments must be dried to a very low water content, thus dewatering and drying would be required for both mechanical and hydraulically dredged materials. Not commercially available or applied on similar site and scale.	High Moderate-Very High (may be able to offset cost by reuse)
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1 - In EPA's 2009 FS Comments EPA notes that this table should include screening technologies by SMA and then assembly a range of alternatives for each SMA. As noted in the Alternatives Screening meeting on April 12, 2011, the LWG cannot yet screen technologies on an SMA basis because SMAs are not yet fully developed. This table summarizes the evaluation of technologies by AOPC for effectiveness, implementability, and cost.

2 - As described in the April 6, 2011 Alternatives Screening presentation, there are portions of AOPCs where some technologies are not effective or implementable. Consequently, "Yes: All AOPCs" indicates that the technology is effective and implementable in at least a portion of all AOPCs.

3 - As described in the April 6, 2011 Alternatives Screening presentation implementability was not evaluated for ex-situ treatment technologies that were not found to be effective.